NEW INSIGHTS INTO CORONA EVOLUTION ON VENUS: IMPLICATIONS FOR MODELS OF ORIGIN; Ellen R. Stofan and Suzanne E. Smrckar, Jet Propulsion Laboratory, California Institute of Technology, Pasadena,CA91109.

Stofan and Head [1] proposed a sequcncc of events for corona evolution based on Vcncra 15/16 data that was generally supported by initial analysis of Magcllan data [2,3]. Coronae arc thought to go through an initial sequcncc of uplift and volcanic construction, accompanied by interior faulting, fracturing and volcanism. Squyrcs ct al. [2] modified this first stage, identifying a number of features having cxtcnsivc radial faulting that they intcrprctcd to be coronae in the early stages of formation. This stage had been predicted by modeling [4] but not seen in Vcncra 15/16 data. This is followed by a second stage of fracture annulus and topographic trough formation and reduction of topography. In the final stage of evolution, coronae have continued volcanism and reduction of topographic relief. The relative timing of annulus and trough formation is not apparent. The three-stage process of corona formation dcscribcd above has been modeled as a rising mantle diapir which raises the overlying lithosphere into a dome-shaped uplift [4-6]. The diapir then flattens as it impinges against the mechanical lithosphere, with the surface topography then evolving to a more plateau-like shape with concentric fractures forming on the rim of the plateau [6]. Finally the diapir cools and loscs buoyancy, with the raised topography relaxing under the force of gravity resulting in additional concentric fractures. Rcccnt studies of corona topography [7] indicate that current models do not predict topographic variations seen at coronae. Work is in progress on a comprehensive model that predicts nearly all of the observed topographic morphologies [8]. In addition, more detailed mapping and analysis of Magcllan data has allowed rcfincmcnt of this sequcncc of events, that will help to constrain modeling of corona formation.

Stage 1. Evidcncc for uplift has been dctcrmincd at several coronae in western Eistla Rcgio [9]. Fragments of older, uplifted plains units can bc seen identified within at least three coronac in this region. The amount of volcanism in this first stage of corona evolution is greater than previously thought. Detailed observations of coronae using full resolution Magcllan data suggest that coronae initially producc sheet-like radial deposits. Most of these large scale flow dcposits extend 1-2 corona radii out from the corona annulus. These deposits predate annulus formation and arc usually overlain by younger, corona-associated volcanic units. At most features, there is no strong cvidcncc of early tectonic deformation; however, any deformation may have been obscured by the intensive volcanism occurring during this stage. A small number of features do show cvidcncc of early radial fracturing.

Stage 2. The relative timing of annulus and trough formation remains difficult to resolve. At several coronae, fractured units appear to have been topographically warpcd after formation, indicating that at some features trough formation may have posdatcd annulus formation. At some coronac, concentric fractures arc locatcd beyond the topographic moat, indicating that annulus formation predated formation of the moat which was subsequently flooded by late-stage volcanism. Radial fractures at several coronae postdate annulus formation, indicating that some amount of uplift may continue wcll into the latter stages of corona formation..

Stage 3. Later stage volcanism at coronae tends to producc more digitatc flows, as wcll as more localized edifices. The change in volcanic style may reflect evolution of the magma chamber underlying the corona. The topography of older coronae (features heavily cmbaycd and crosscut by regional deformation) indicate that corona topography dots appear to dccrcasc in the later stages of evolution. Many coronae correspond to depressions or have interiors lower than the surrounding plains [7]. These depressions can bc modclcd as regions of thinned lithosphere that have isostatically adjusted aftcr the upwclling cools [other abstract].

Constrains *on corona-associated volcanism* The amount and timing of volcanism provide additional constraints on models of corona evolution. Previously, Stofan ct al. [3] found that 9% of coronac were associated with large amounts of volcanism, 68% with modcratc amounts of volcanism, and 2370 with little associated volcanism. Roberts and Head [10] found that 41% of large coronae had extensive flow deposits surrounding thcm. A more detailed survey of coronae utilizing full resolution Magcllan data indicates that most coronae arc surrounded by cxtcnsivc deposits (as described above), indicating that the number of coronae with large amounts of associated volcanism is higher than previously estimated. In order to constrain the amount of volcanism at coronae, the volumes of five coronae were measured. The entire feature was assumed to be extrusive in origin. This approaches an upper bound on the amount of volcanism associated with each coronae as the topography associated with each feature may be partially due to intrusion and uplift, although it does not include distal flows which maybe volumetrically significant but arc too thin to calculate a reliable volume. Coronae volumes ranged from 1.1 x 10^4 km^3 to 1.9 x 10^5 km^3. This is similar to the volumes of hotspot-related large shields on Venus, which have volumes ranging from 1.6 x 10^4 km^3 at Sif Mons to 3.0 x 10^5 km^3 at Ozza Mons [11]. At terrestrial edifices, the ratio of intrusion to total melt volume ranges from about 1:2 to 1:10 [12-15]. Assuming similar ratios for coronae yields total melt volumes on the order of 10^4-10^6 km^3.

Implication for models of corona formation. Previous models have relied on matching the topographic signature of coronae to determine the depth of diapiric upwelling. Models of corona formation that predict pressure-release melting can be used to bound the depth and temperature of the upwelling by matching the timing and estimated volcanic volumes. Existing models predict early stage radial fracturing at coronae. The presence of late-stage radial fractures, as discussed above, may indicate that some coronae have been affected by secondary or even multiple episodes of upwelling. The complex topography of coronae [7] is not predicted by current models [4-6], and may also require more complex models of corona formation to be developed.

Conclusions. The sequence of events in corona evolution has largely been supported by more detailed studies. However, significant variations in volcanic style arc seen, which models of corona evolution must address. The presence of sheet-like flows at coronae provide evidence that coronae are locally significant contributors to the formation of plains on Venus. Detailed geologic mapping of Venus currently being conducted will undoubtedly provide additional important modifications to the evolutionary sequence for coronae, and a better understanding of the variations between features.

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